Argonne National Laboratory

The Integrated Ocean Architecture - a Framework for Generating Seamless Oceanic Representations for Modeling & Simulation Applications

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Integrated Ocean Architecture Project: Background

- The long-term need of the DoD's Ocean Executive Agent (OEA) is for the development of a virtual maritime environment within which diverse domain processes can interact to support Naval operations such as Operational Maneuver From The Sea (OMFTS)

- The OEA has been sponsoring an Integrated Ocean Project (IOP) to develop the suite of models that produce oceanic representation in different domains, but has lacked an architecture that can seamlessly integrate these models.

Integrated Ocean Architecture: Background (Cont.)

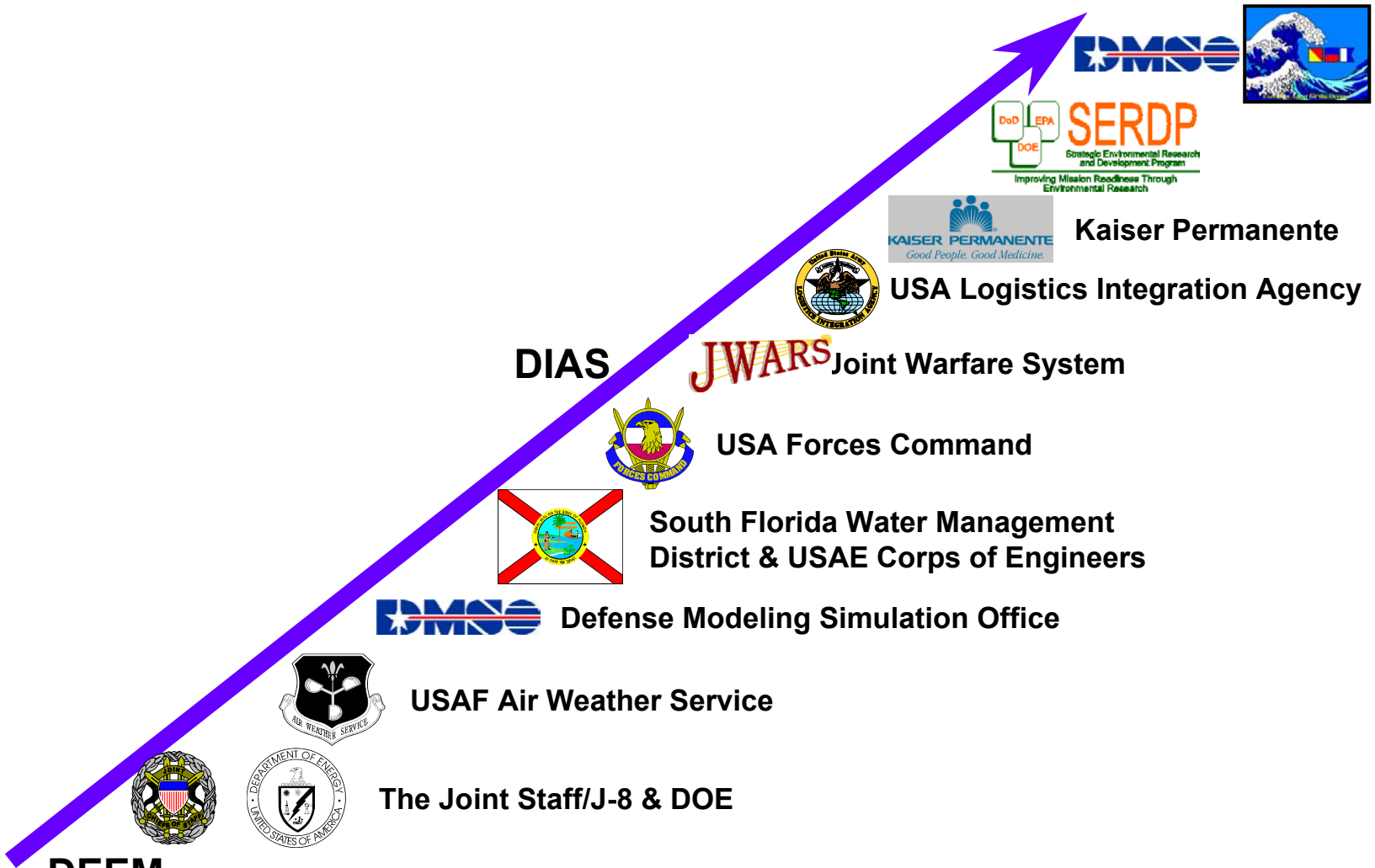
- In FY99, Argonne was funded to use DIAS to develop the Integrated Ocean Architecture (IOA)
- IOA partners include Naval Research Laboratory Stennis Space Center and USA COE Waterways Experiment Station
- IOA was developed as a two year program:
  - The FY99 focus was to produce surf zone forecasts for the selection of amphibious landing areas
  - The FY00 focus was intended to extend the IOA to a full ocean representation and to begin the transition to an operational system

Integrated Ocean Architecture: Background (Cont.)

- The IOP suite of ocean models, supplied by NRL:
  - WAM - oceanic wind-driven wave generation and propagation
  - ADCIRC* - tide and wind effects on water surface elevation
  - STWAVE - nearshore wave propagation (for simple shorelines)
  - REF/DIF* - nearshore wave propagation (for complex shorelines)
  - SURF3.0 - surf zone wave characteristics

*Planned for integration into the IOA in FY00

DIAS Evolution and Sponsor Applications



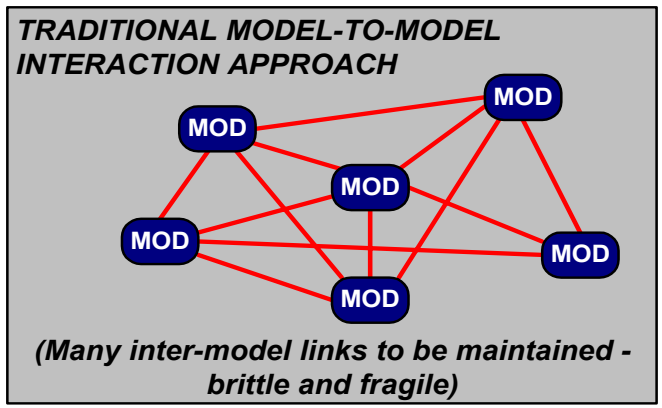
DIAS Facilitates Building and Maintaining Complex Multidisciplinary Simulations

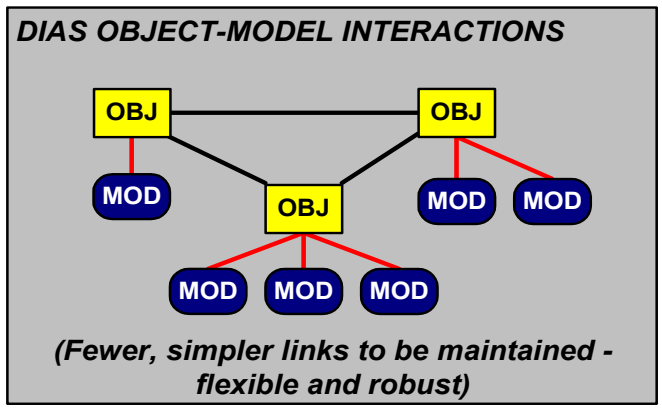
- DIAS is an object-based software *framework* for modeling and simulation
- The DIAS software infrastructure allows many disparate simulation models and other applications to work together harmoniously to address a complex problem
- Main components of a DIAS simulation:
  - Software objects that represent the real-world entities that comprise the problem space
  - Simulation models and other applications that express the dynamic behaviors of the domain entities. Existing "legacy" models in virtually any software language can be used in complex DIAS simulations

New Web Site: http://www.dis.anl.gov/DIAS

The DIAS Framework Is Flexible and Extensible

- In DIAS, models communicate only with domain objects, never directly with each other - making it easier to add or swap alternative models in and out without re-coding





- DIAS objects are adjustable to the context of the problem:
  - objects have flexible, variable attribute lists -- can be tailored to need
  - abstraction of object behaviors -- objects don't "know" about model internals, so objects are simpler and more reusable

A Large and Growing DIAS Object Library Supports Construction of New Simulation Systems

Object Classes in DIAS Object Library

(Not an exhaustive list)

- Ephemeris
- Atmosphere

- Hydrosphere
- GroundWater
- SurfaceWater
- HydroLayer
- WaterBody
  - Stream
  - ExternalStream
  - Pool
    - Offshore
    - Nearshore
    - SurfZone
  - ExternalPool
- Shore

- AreaOfInterest
- AvenueOfApproach

- EarthSurface

- Cover
  - SoilCover
  - WaterCover
  - SnowIceCover
  - SurfaceCover
    - Developed
    - Bare
    - Wetland
    - Grassland
    - Forest
    - Cane
    - Plantation
    - Cropland
    - Vineyard
    - Scrub
  - Microterrain

- TransportNet
- TransportLink
  - TransportArc
    - AirArc
    - RailArc
    - RoadArc
  - TransportNexus
    - Airfield
    - Railyard
  - HydroNexus
    - CatchmentNexus
    - OpenWaterNexus
- TransportNode
  - TransportJunction
    - AirJunction
    - RailJunction
    - RoadJunction
    - HydroJunction
  - TransportBoundary
    - HydroBoundary
    - Littoral

- Artifact
  - Structure
    - Building
  - Vehicle
    - LandVehicle

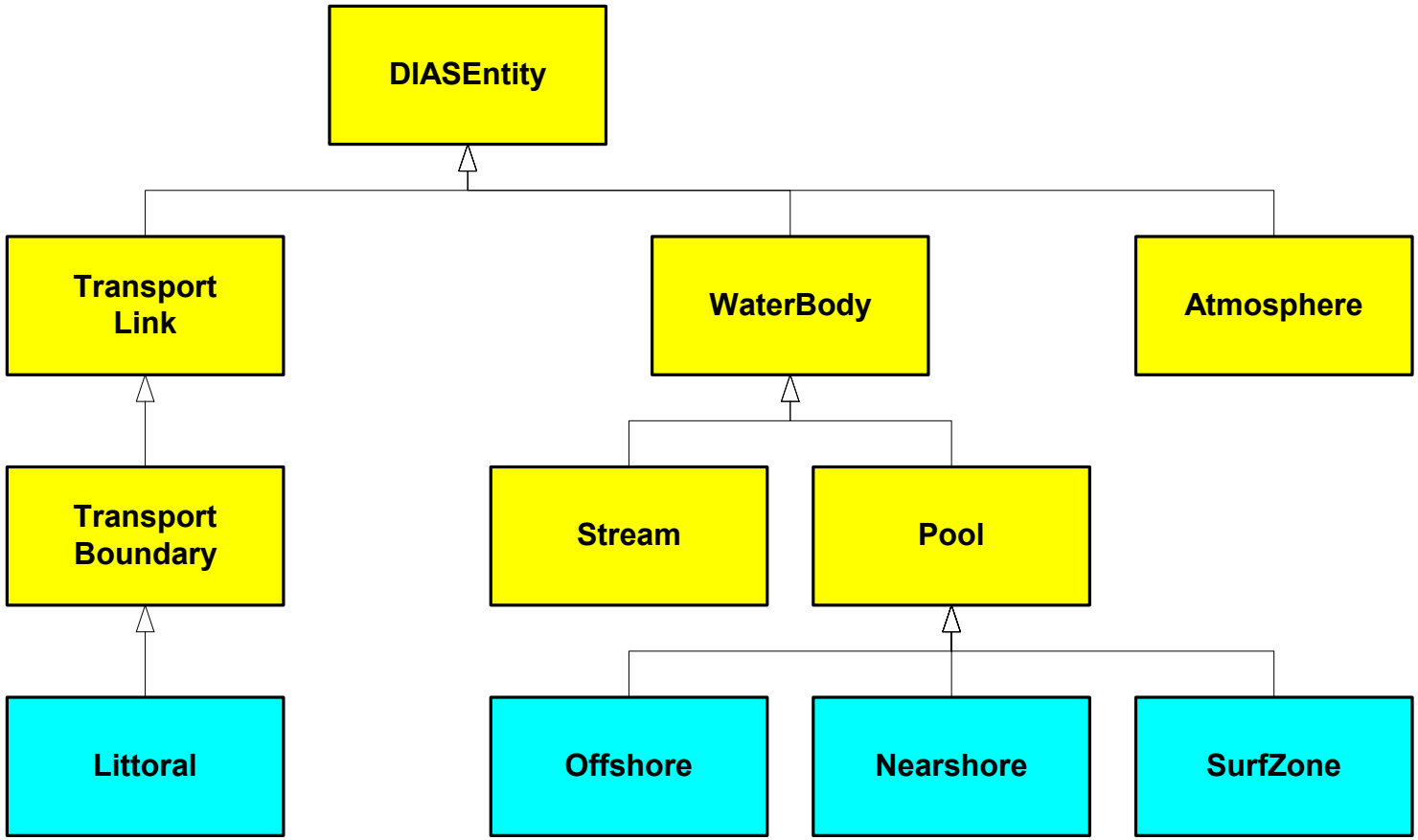
- ArcPathway
  - Bridge, BridgeSpan
  - Ferry
  - Ford
  - Tunnel

- NodeQualifier
  - Constriction
  - DropGateRail
  - DropGateRoad
  - HydroStructure
  - HydroCulvert
  - HydroGatedCulvert
  - HydroGatedSpillway
  - HydroPump
  - HydroWell
  - HydroDrain
- Levee
- LeveeSection

- Person
- Physiology
- PhysiologicalSystem

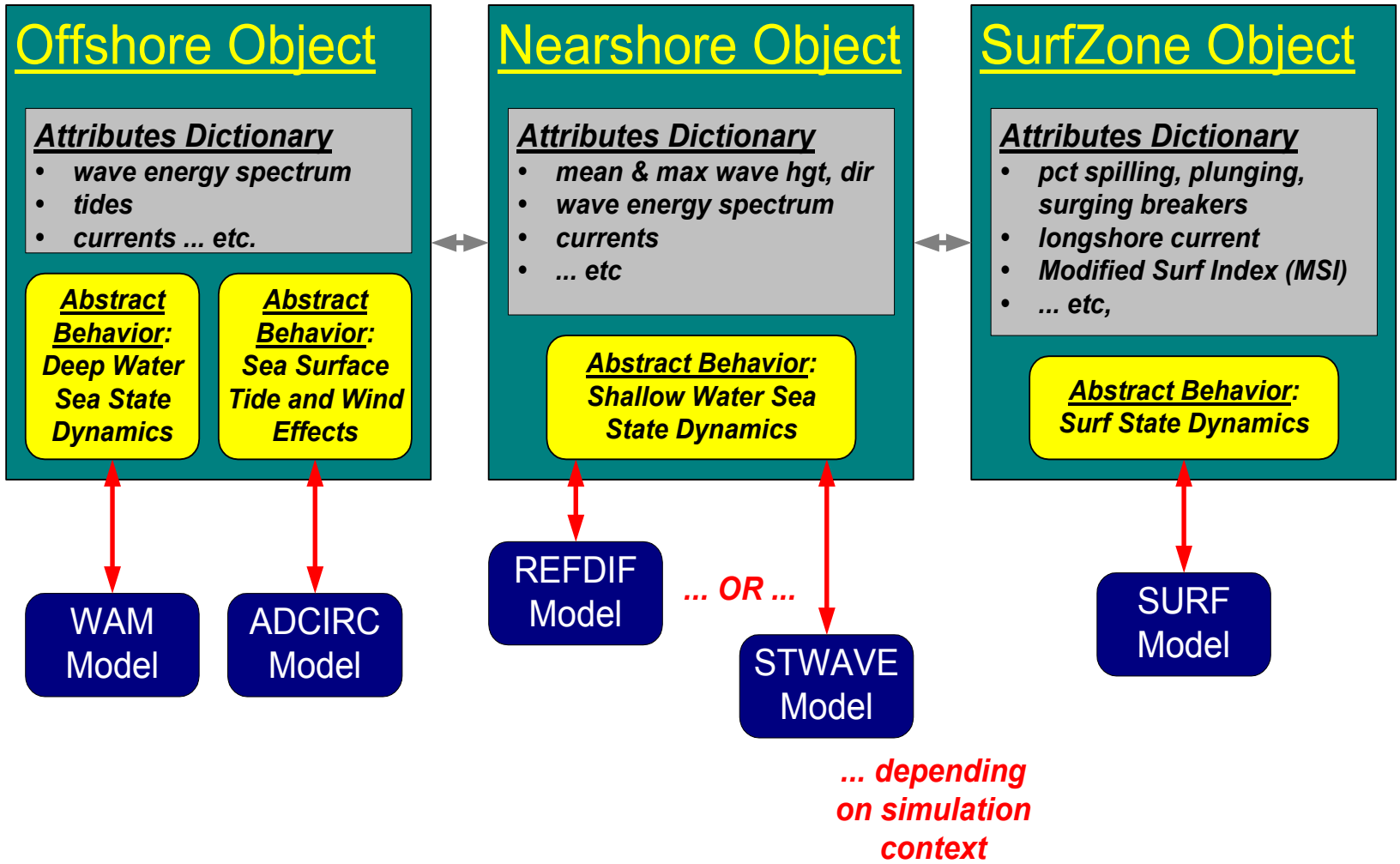
- Organization
  - MedicalDepartment
  - Family

The IOA Reuses Many Objects from the DIAS Object Library

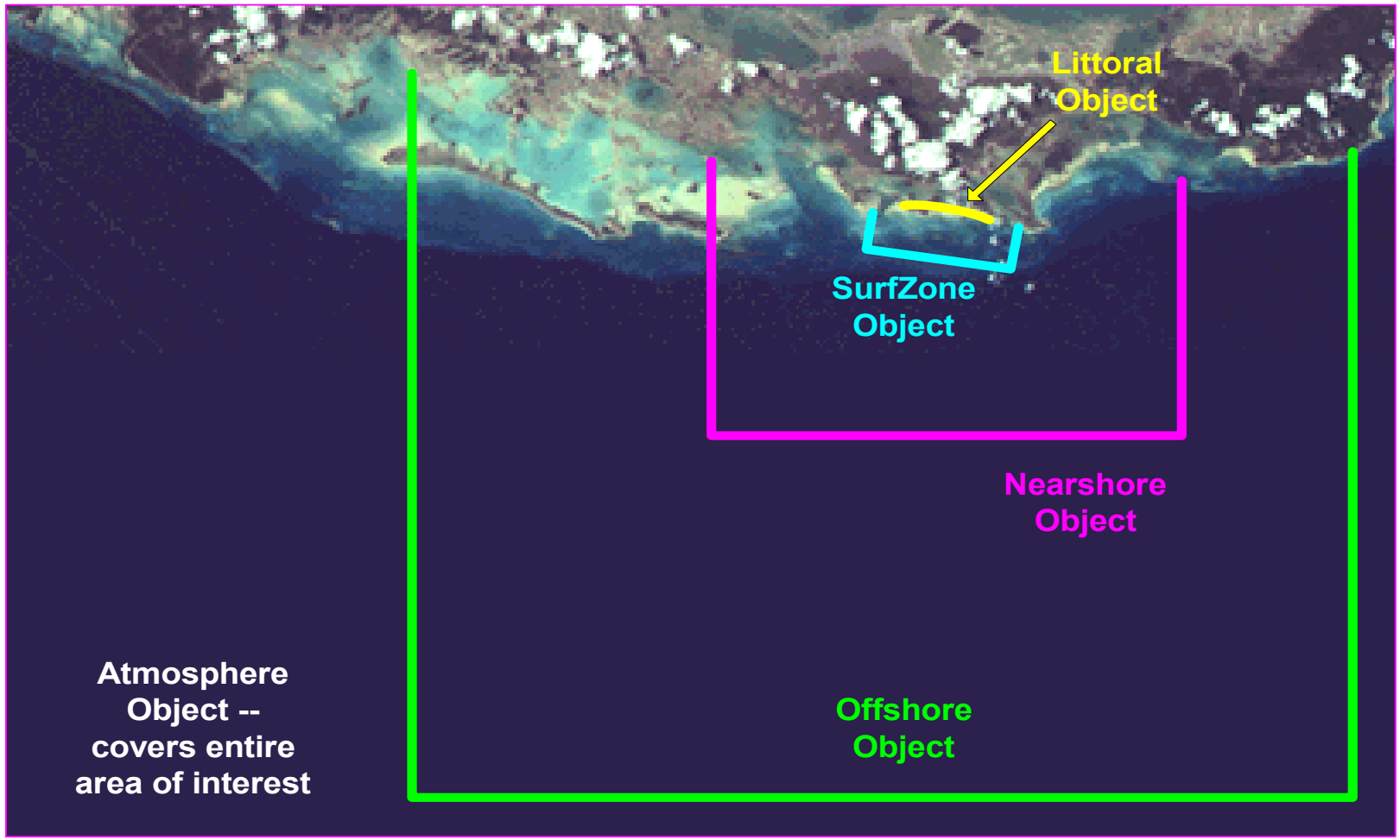


(Reused objects in yellow and new objects in blue)

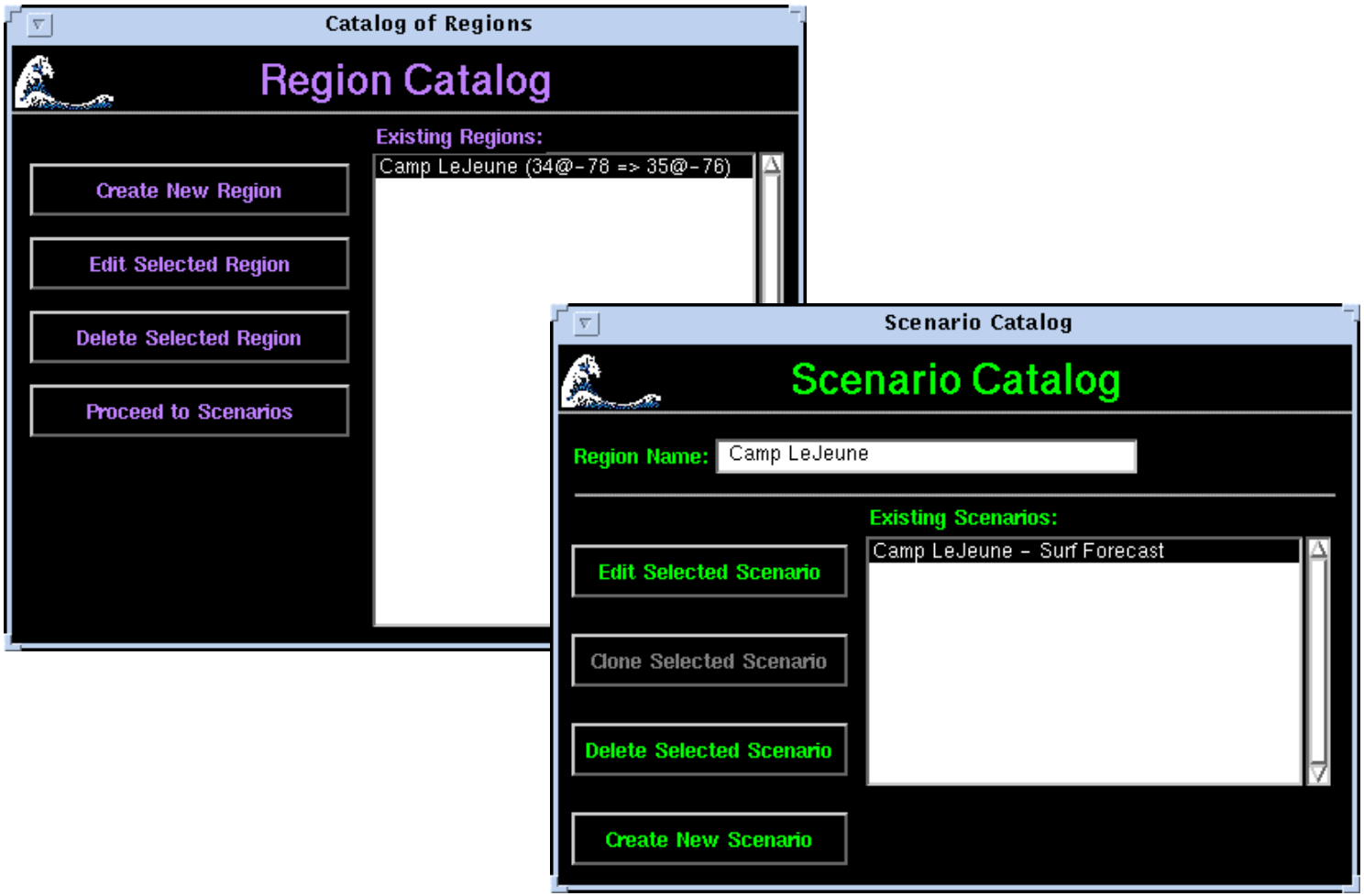
DIAS Ocean Object - Model Interactions



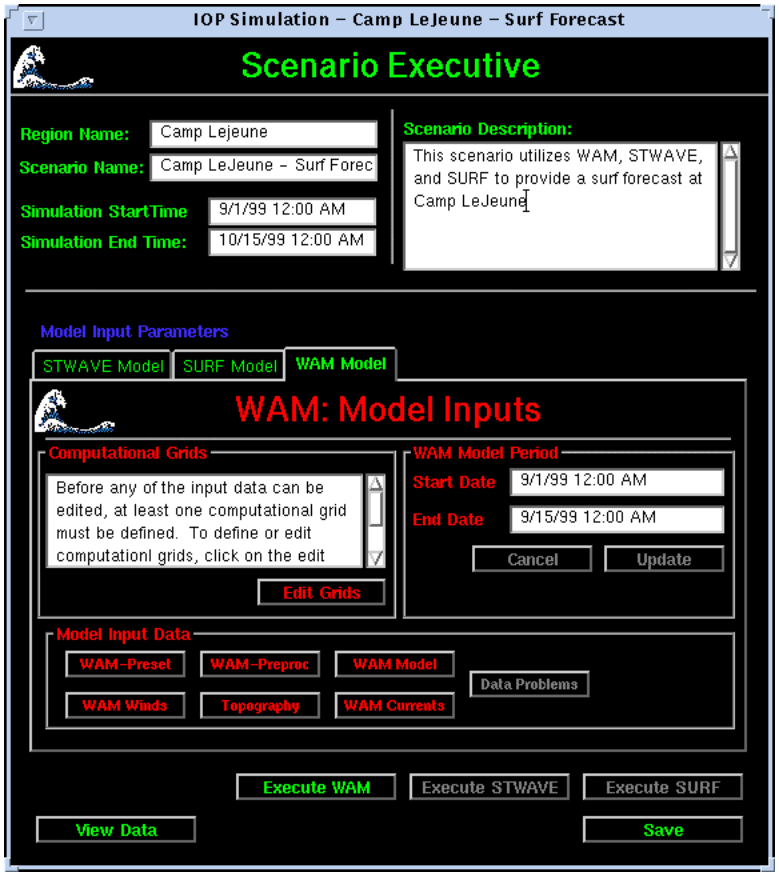
Integrated Ocean Project: Example of Spatial Layout of DIAS Domain Objects

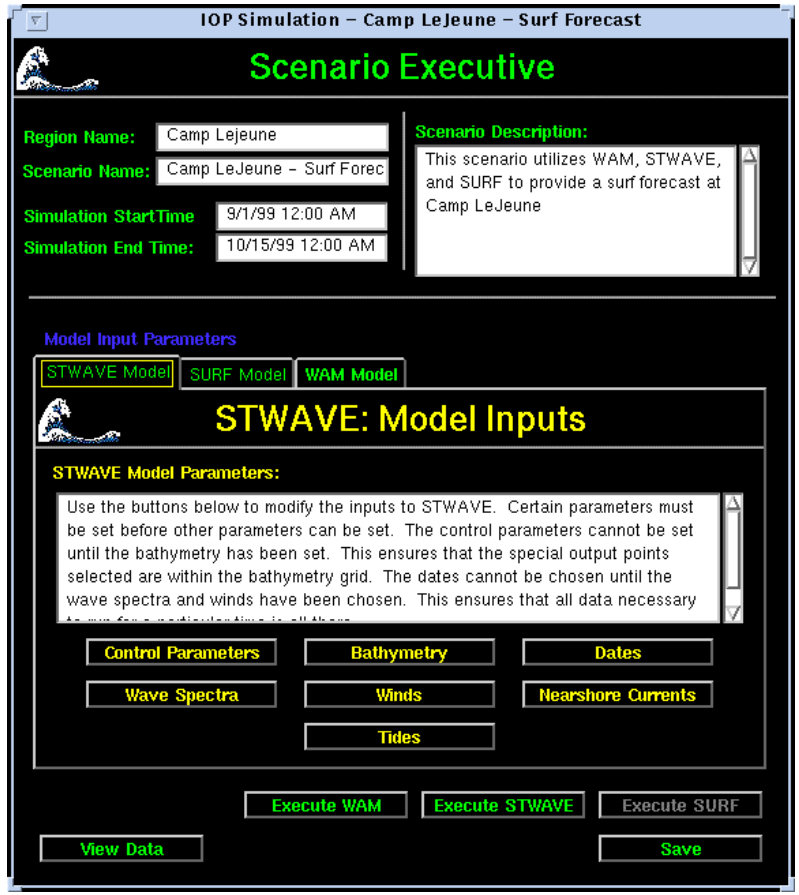


Selecting a Region and Scenario

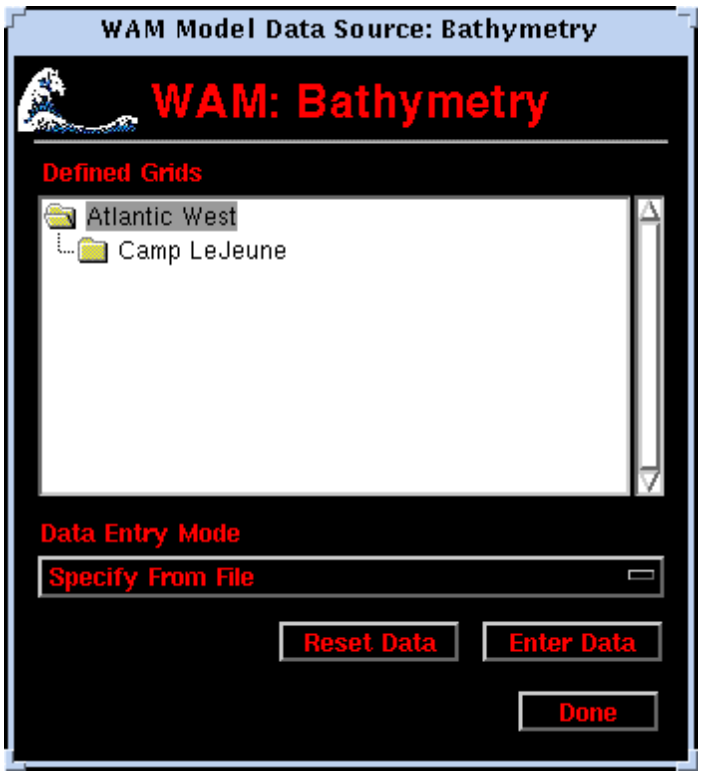


A "Scenario Executive" Controls the Setting Up of Model Inputs





IOA Supports Easy Data Entry and Data Checking Tools



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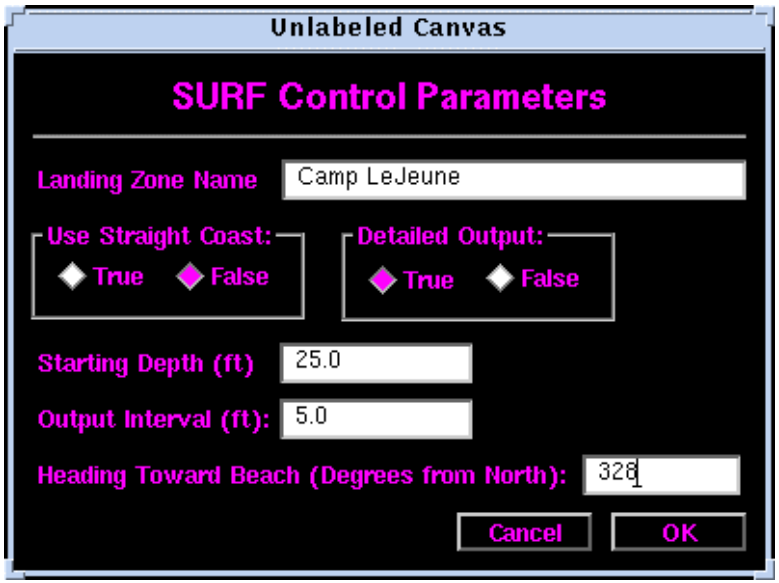
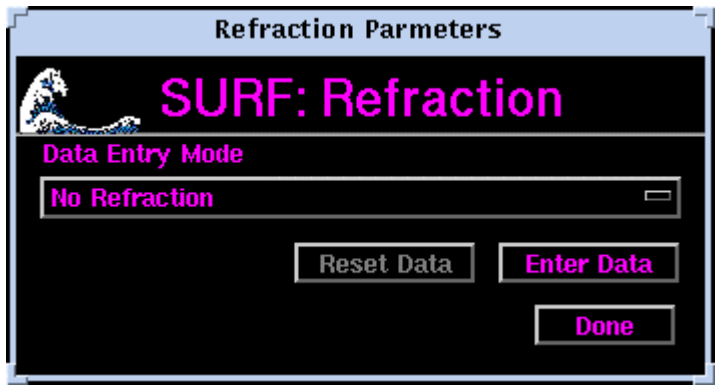
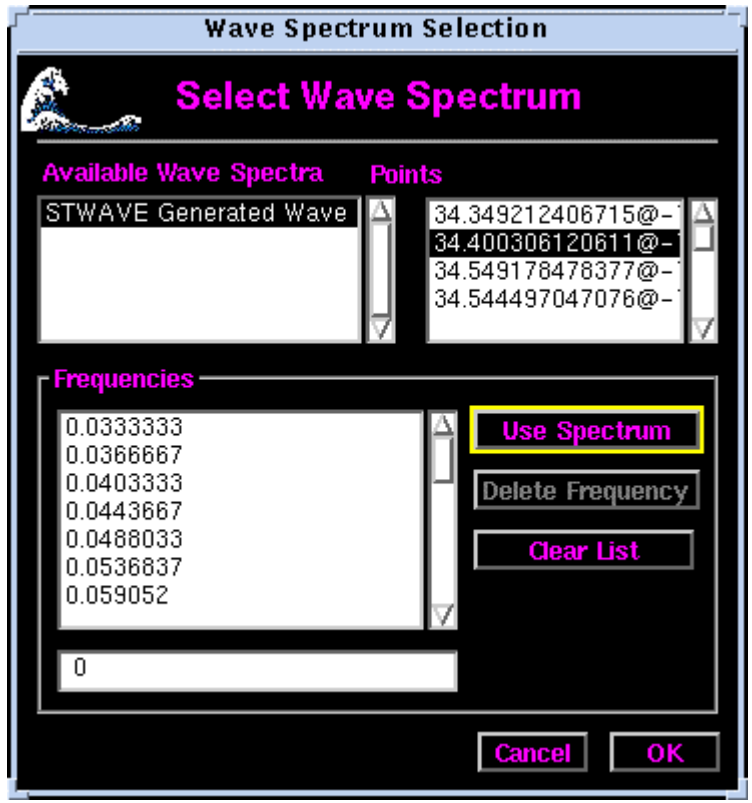
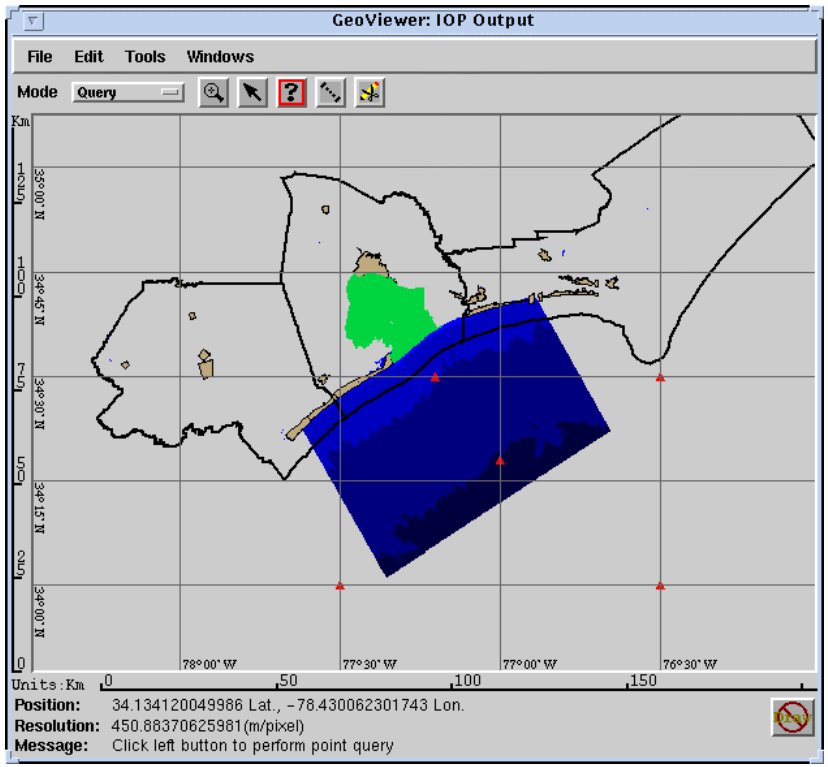


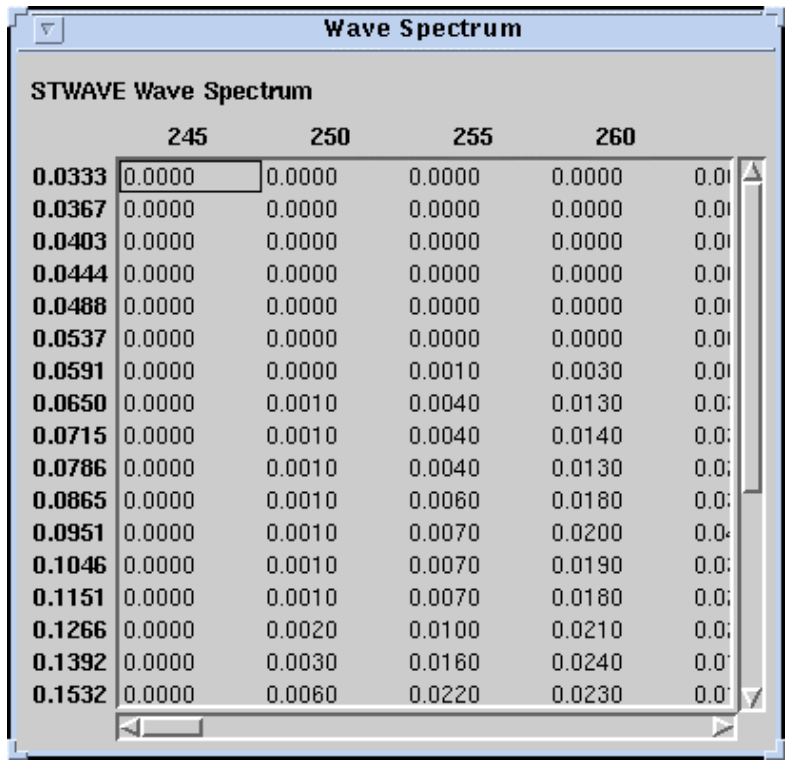




IOA Uses Argonne's GeoViewer for Display and Manipulation



Graphical Display of Wave Spectra Points



	245	250	255	260	
0.0333	0.0000	0.0000	0.0000	0.0000	0.0
0.0367	0.0000	0.0000	0.0000	0.0000	0.0
0.0403	0.0000	0.0000	0.0000	0.0000	0.0
0.0444	0.0000	0.0000	0.0000	0.0000	0.0
0.0488	0.0000	0.0000	0.0000	0.0000	0.0
0.0537	0.0000	0.0000	0.0000	0.0000	0.0
0.0591	0.0000	0.0000	0.0010	0.0030	0.0
0.0650	0.0000	0.0010	0.0040	0.0130	0.0
0.0715	0.0000	0.0010	0.0040	0.0140	0.0
0.0786	0.0000	0.0010	0.0040	0.0130	0.0
0.0865	0.0000	0.0010	0.0060	0.0180	0.0
0.0951	0.0000	0.0010	0.0070	0.0200	0.0
0.1046	0.0000	0.0010	0.0070	0.0190	0.0
0.1151	0.0000	0.0010	0.0070	0.0180	0.0
0.1266	0.0000	0.0020	0.0100	0.0210	0.0
0.1392	0.0000	0.0030	0.0160	0.0240	0.0
0.1532	0.0000	0.0060	0.0220	0.0230	0.0

Tabular Display of Wave Spectra Points